LIFE CYCLE ASSESSMENT OF SOLAR CHIMNEYS

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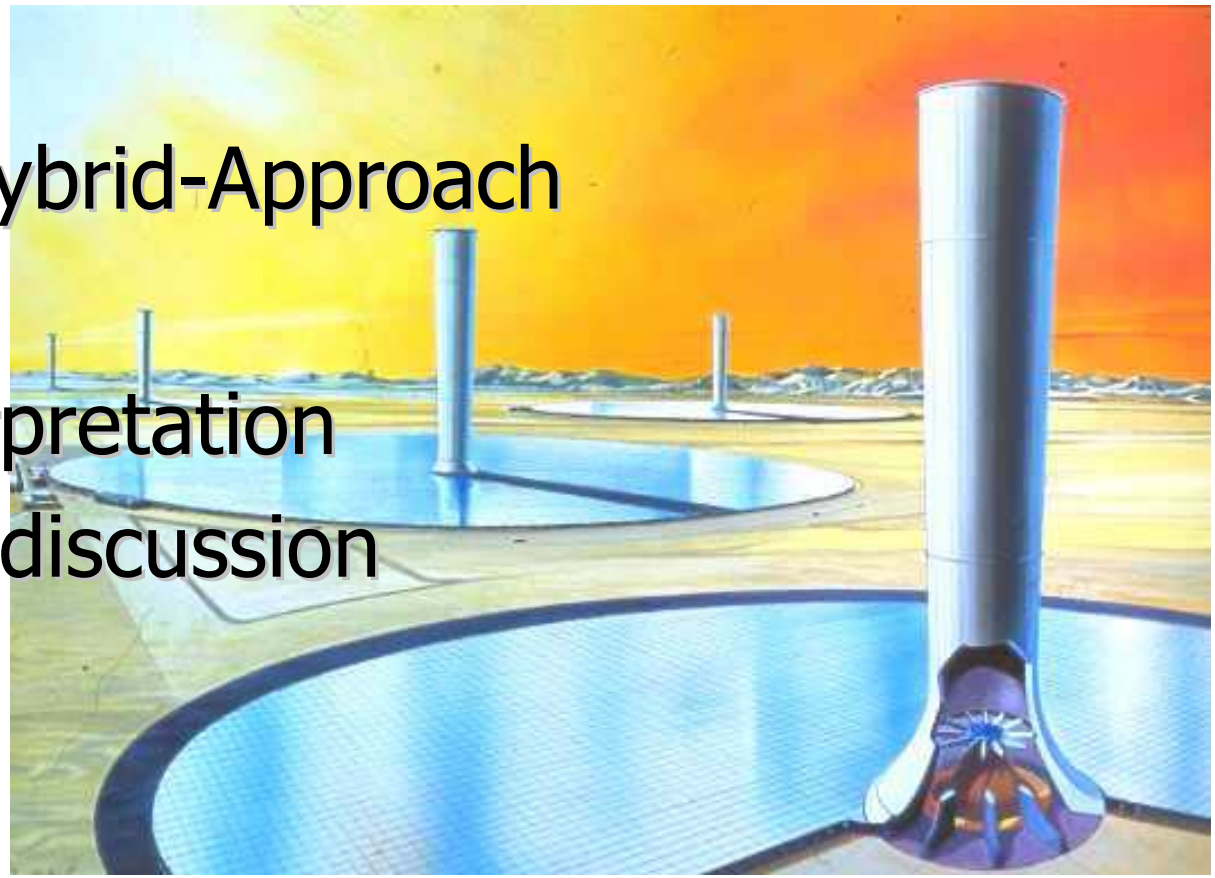
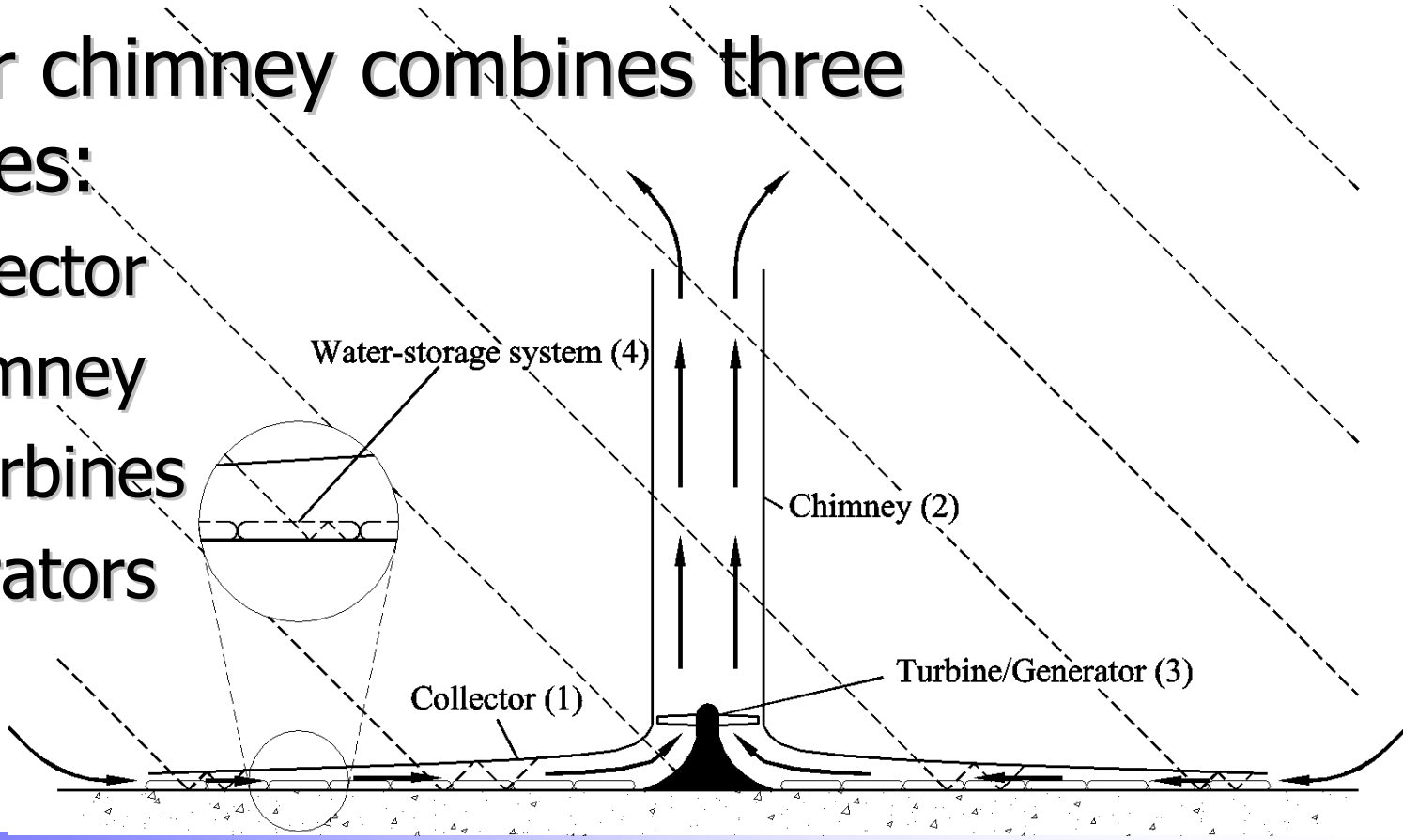
Outline

- Introduction
- LCA and the Hybrid-Approach
- Methodology
- Results & interpretation
- Conclusions & discussion

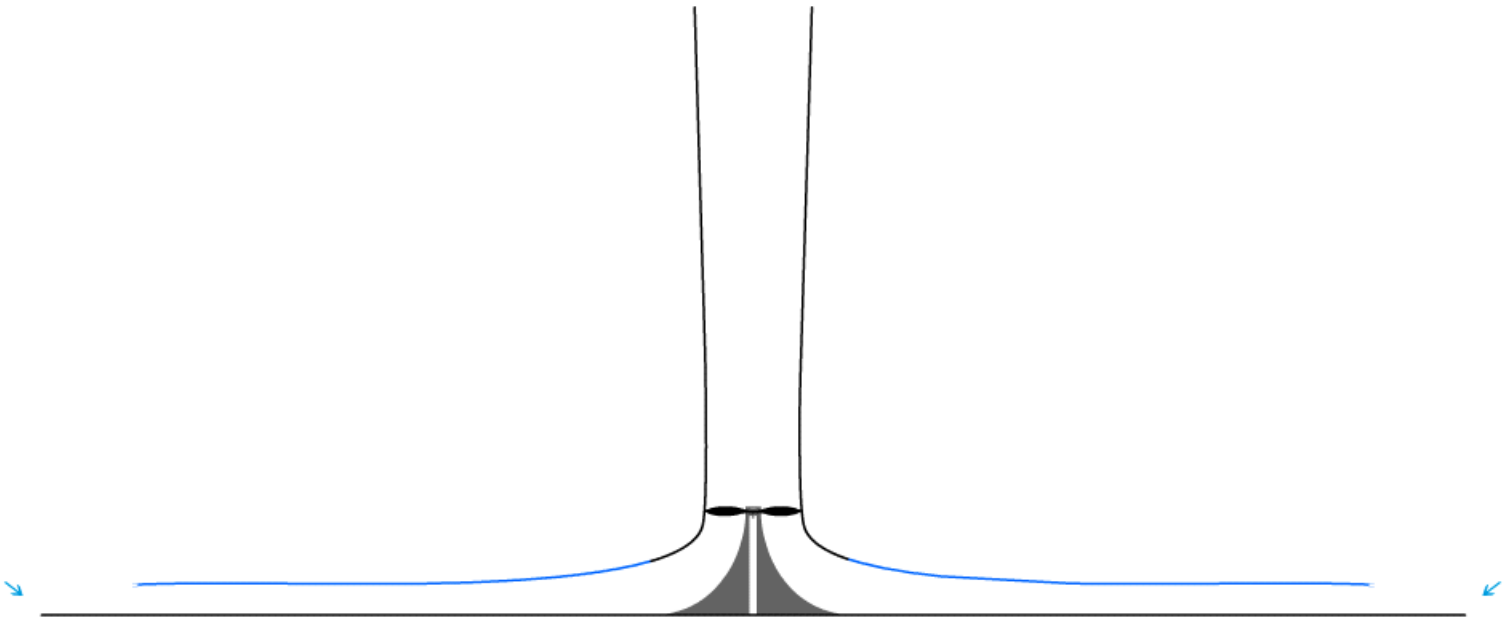


Introduction

- The solar chimney combines three techniques:
  - the collector
  - the chimney
  - wind turbines & generators

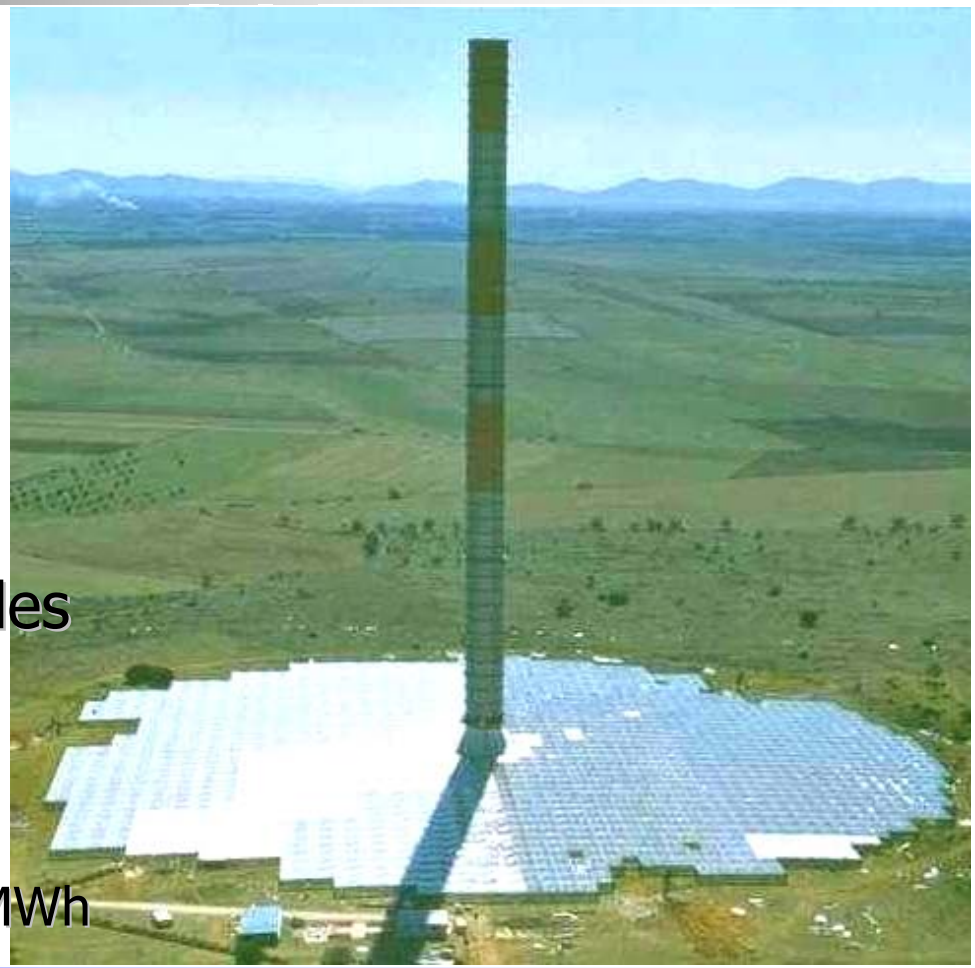


Functioning



Prototype in Manzanares-Spain

- period of project: 9 years
- period of tests: 3 years
- collector: Ø 240 m
- chimney: Ø 10 m
  high: 195 m
- power: 50 kW
- turbine: vertical axis/four blades
- total balance (1978):
  - total production time: 3157 h
  - night production: 244 h
  - total annual production: 44,19 MWh

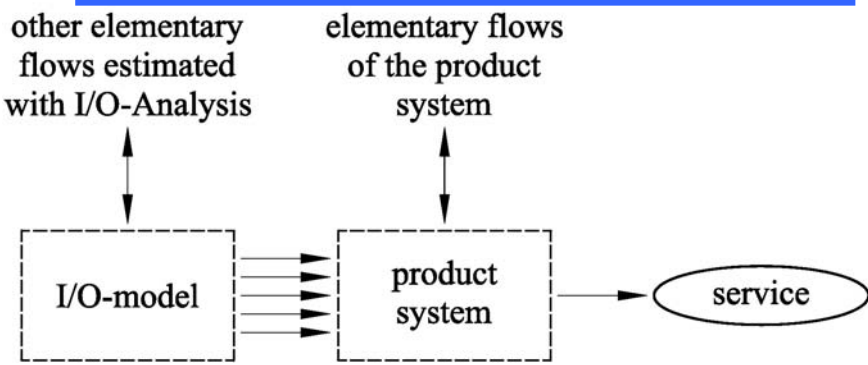


Methodology

LCA → accounts for all impacts that a particular product might have from the extraction and supply of the raw materials through production and usage to when it is finally disposed of as waste (ISO14041/1998)

Hybrid-Approach completes the generally used Process Chain Analysis by a model based on economic Input-Output-Tables (Marheineke et al. 1999)

allow a quick and easy estimation of the elementary flows of up- and downstream processes and commodity flows which are neglected and not included in the Process Chain Analysis

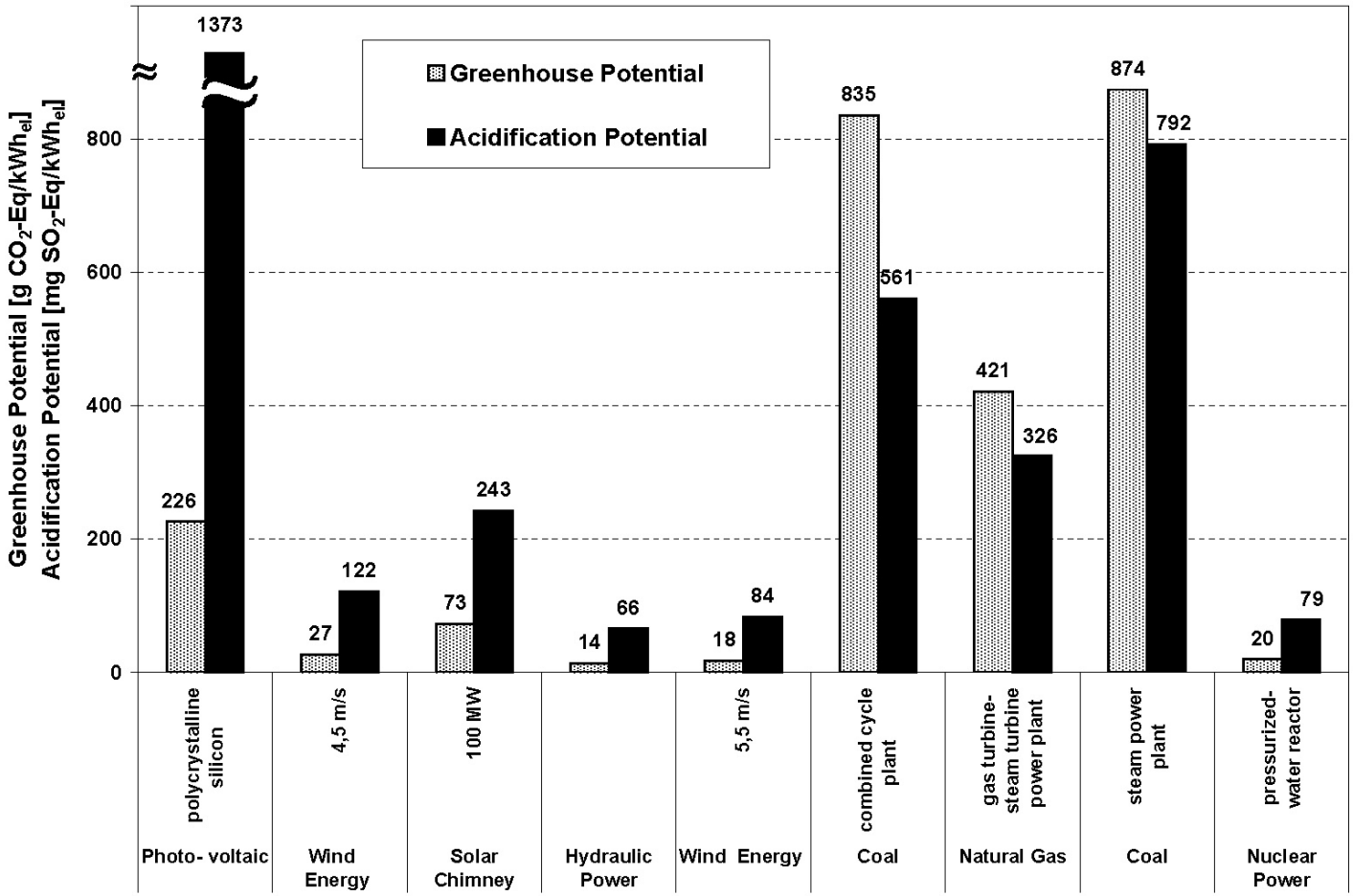


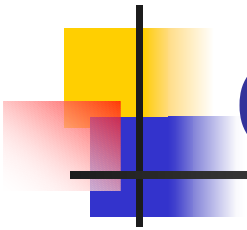
Results

- CO_2-, SO_2-emissions and use of mineral resources for construction, operation, maintenance and dismantling of solar chimneys

Power [MW_{el}]	CO_2-eq. [g/kWh]	SO_2-eq. [mg/kWh]	Copper [mg/kWh]	Bauxite [mg/kWh]	Iron [mg/kWh]	Chalk [mg/kWh]
5	172	565	6	896	40,168	53,305
30	108	358	4	572	25,594	31,284
100	73	243	3	380	17,040	20,636

Comparison


Greenhouse Potential
Acidification Potential
Greenhouse Potential [g CO_2-Eq/kWh$_{el}$]
Acidification Potential [mg SO_2-Eq/kWh$_{el}$]
0
200
400
600
800
1373
226
27
122
73
243
14
66
18
84
835
561
421
326
874
792
20
79
polycrystalline silicon
Photo- voltaic
4,5 m/s
Wind Energy
100 MW
Solar Chimney
Hydraulic Power
5,5 m/s
Wind Energy
combined cycle plant
Coal
gas turbine-steam turbine power plant
Natural Gas
steam power plant
Coal
pressurized-water reactor
Nuclear Power



Conclusions

- ecological evaluation of solar chimney has been developed
- large solar chimneys can help the relieving of the environment and the saving natural resources due its relative low CO_2 and SO_2-emissions